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THE INCIDENCE OF SAVAGING AND OTHER TYPES OF MORTALITY IN FIRST AND SECOND PARITY PIGS

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THE INCIDENCE OF SAVAGING IN FIRST AND SECOND PARITY PIGS

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Abstract

A survey was designed to investigate the incidence of piglet-directed aggression on seven large (600 or 2400 gilt), new pig units during the first two farrowing cycles. Sows and gilts were subject to a light (continuous or intermittent light) and/or sound (newborn piglet vocalizations or no vocalizations) treatment, applied on a farrowing room basis, starting three to five days before farrowing and ending when the last room occupant had given birth. Behaviour records were collected for 6625 gilts during the first farrowing cycle, and for 2175 gilts and 5232 sows during the second. The incidence of savaging and number of piglets affected (killed or injured) by it, and factors associated with piglet-directed aggressive behaviour, were recorded. Piglet-directed aggression was scored as 0 (none), 1 (moderate) or 2 (severe). A score of 2 indicated that one or more piglets were injured or killed and/or human intervention was required to control the aggression, while aggression that did not result in piglet injury or death, and did not require human intervention, scored 1.

During the first farrowing cycle, 506 (0.8%) piglets were affected (killed or injured) by savaging; of these, 393 (0.6%) piglets were killed. Three hundred and thirty one gilts (5.0%) displayed some degree of aggression towards their piglets (scoring either 1 or 2), while 201 (3.03%) killed one or more piglets. Savaging levels were similar for the gilts in the second farrowing cycle, while the problems were reduced to approximately half among the sows. There was considerable variation between farms in reported incidence of savaging and numbers of piglets affected. Percentages of piglets killed by savaging (of piglets born alive) ranged from 0.1%-1.1%, and percentages of gilts killing one or more piglets ranged from 0.8% to 5.8%. Thus, the contribution made by savaging to total reported preweaning piglet mortality varied between little (3% for one 2400 gilt farm) and very considerable (25% for one 600 gilt farm).

Continuous light resulted in a reduction in the proportion of piglets killed due to savaging (0.47 vs 0.77%; $p<0.05$) and reduced total piglet mortality (0.62 vs 0.74 piglets/litter; $p<0.05$).

Gilts in crates situated in the centre of the farrowing rooms receiving the Sound treatment fatally savaged more piglets per litter than did those in either the front or the back (0.12 vs 0.05 and 0.07, respectively; $p<0.05$).

Piglet-directed aggression and savaging did not vary with gilts' genetic line. Similarly, there was no significant relationship between savaging and gestation length, body condition score, induction or non-induction of farrowing, the use or non-use of oxytocin or manual intervention during farrowing, or litter sex ratio. We hypothesized that the incidence of savaging would decrease over time from the start-up of the new units, as both people and pigs became more familiar with their surroundings. There was a trend for this pattern in our results.

Introduction

The incidence of infanticide and offspring-directed aggression ('savaging') in gilts and sows has been the subject of widely ranging, predominantly speculative, estimates. A complicating factor has been the variety of ways in which savaging has been defined (ranging from any evidence of aggression to actual piglet deaths), and lack of consistency in study methodology. For example, Craig (1981), citing a personal communication from R. Hines but no experimental evidence, suggested that less than 0.5% of gilts kill piglets at farrowing, while Knap and Merks (1987), using stockperson scoring, reported "vigorous aggression" in about 8% of parturient gilts. Cronin and Smith (1992) reported that 18.8% of gilts fatally savaged piglets. In a study during which 31 farrowings were continuously observed, 89% of gilts and 20-25% of sows attempted to attack their piglets, although few piglets were injured and none killed (English et al., 1984).

It has been documented that gilts, giving birth for the first time, are more likely to direct aggression at their newborns than are more experienced sows (English et al., 1984; Spicer et al., 1986). It has also been suggested, with little supporting evidence, that levels of savaging are higher in all-gilt populations, such as on a new or repopulated unit. According to Smith and Penny (1986), " ... the incidence is higher in recently established all-gilt herds. Under such circumstances it may occur in near epidemic proportions and a form of hysteria may develop which seems to pass from gilt to gilt". Luescher et al. (1989) concurred with this statement, adding that "[according] to our own experience, 50% of litters may be affected in such herds".

A preliminary study of savaging levels on two pig units (Harris and Gonyou, 1998) found the incidence of piglets being fatally savaged was higher among gilts farrowing in an all-gilt environment than in either gilts or multiparous sows on an mixed-parity unit: 7% of gilts in all-gilt rooms killed one or more of their piglets by savaging, compared to 5% of gilts and 2% of sows in mixed rooms. These differences may have been influenced by variability in piglet-

directed aggression levels between individual farms. The extent of variation in piglet-directed aggression between farms of similar size, using similar management practices, is unknown.

Multiple environmental, social and physical features of the sow and litter may affect piglet-directed aggression. During our preliminary study, an association was noted between large litter sizes and savaging in gilts. Since the incidence of savaging is generally low (approximately two sows and five to seven gilts in one hundred), a large-scale study is necessary to accurately evaluate factors affecting savaging. A large-scale, mixed survey/experimental format study was designed to examine the incidence and correlates of fatal and non-fatal piglet-directed aggression on seven large, new pig barns which opened in Saskatchewan between January and June 1999. Two environmental treatments were applied, to assess the effect of continuous versus intermittent farrowing room lighting and/or a playback of newborn piglet vocalizations versus none in the farrowing room, on the incidence of piglet-directed aggression, piglet deaths and injuries due to savaging, and overall preweaning piglet mortality.

Materials and Methods

Facilities and Animals

Seven newly built pig operations situated within Saskatchewan were used for this study. Operations belonged to one of two management groups. Management group A's barns were designed to house 2400 breeding females, and management group B's barns were designed to house 600 breeding females. Within the groups, buildings and management practices were similar or identical. On each farm, the study started at the time of the first farrowing and continued until the end of the second farrowing cycle, approximately ten months later. Farrowing units were not filled to capacity at the start of production, and numbers of farrowing gilts (and thus amount of study data) varied within units of the same size. Due to difficulties with study compliance on one 2400 animal unit, data from the first half of the first farrowing cycle were not available for analysis. The first farrowing cycle was comprised entirely of gilts. The second farrowing cycle included both sows (2^{nd} parity) and gilts.

Sows and gilts were of several hybrid genetic lines. Each management group was supplied by a different breeding company, and within the groups, farms each used two (Group A) or between one and three (Group B) genetic lines.

Group A farrowing units held 15 farrowing rooms, each containing 28 farrowing crates. Group B farrowing units held four full farrowing rooms, each containing 24 farrowing crates, and one half-size room containing 12 crates. For analytical purposes rooms were divided into front, middle and back zones, dependent on crate number. Figure 1 illustrates the arrangement of farrowing crates within the rooms, and the allocation of crates to zones. Both sows and gilts gestated in stalls and were transferred to farrowing crates approximately five days before their expected date of delivery. An exception to this schedule occurred on several farms during the first fill of the farrowing rooms, in that gilts were moved into the farrowing rooms as much as 4 weeks before parturition. Farrowing rooms were filled and emptied using an 'all-in-all-out'

schedule: thus the rooms were filled with animals due to farrow within a few days of each other, and then emptied approximately three weeks after the farrowings. Following emptying, rooms were cleaned and refilled with a new batch of pre-parturient animals.

Induction of farrowing, when used, was by injection of cloprostenol (Estrumate®, Schering-Plough, Pointe Claire, QC, Canada). Parturition was augmented, when it was judged necessary by stockpersons, using manual intervention and/or injection of oxytocin. If savaging or piglet-directed aggression were observed by stockpersons, intervention occurred according to the farm's usual practice. This generally consisted of confining piglets temporarily at the back of the farrowing pen, and sometimes also the administration of the sedative azaperone (Stresnil®, Janssen, Toronto, ON, Canada, 2.2 mg/kg IM).

The experimenters did not intervene in or alter barns' usual routines or management of females and litters either prior to, during or after farrowing, except to impose the environmental treatments and require stockpersons to record the additional data needed for the study. The experimenters were not present during farrowing. Stockpersons attended farrowing according to their usual routines.

Light and Sound Treatments

Gilts were subject to continuous light (CL) or an intermittent light (IL) treatment and a sound (S) or no sound (NS) treatments, applied to the farrowing rooms from approximately three to five days before farrowing until the last room occupant had finished farrowing. Treatments were arranged in a factorial design, within blocks of four farrowing rooms: CL-S, CL-NS, IL-S, and IL-NS. On Group A farrowing units, where there were 15 farrowing rooms, this arrangement was replicated four times for all combinations except CL-S, which was replicated only 3 times. On Group B units, the half-size room received IL-NS. Rooms were allocated to the same treatment throughout the study.

The CL treatment consisted of continuous, 24-hour-a-day light, while IL was the farm's usual, intermittent light schedule which varied from 8 h light:16 h dark to 15.5 h light:8.5 h dark. Each farm used a slightly different light:dark schedule: on group A operations the daily light period was of 8 – 10 hours' duration, while within group B it was longer, at between 12 and 15.5 hours. On group B units all room lights except for piglet heat lamps were turned off during the dark period, but on group A farms a single fluorescent light, located at the front of the room, was left on at all times.

The S treatment was a recording of several tracks of newborn piglet vocalizations, played continuously through two wall speakers placed on one side of the farrowing room (Figure 1) and connected to a CD player located outside the room; in the NS treatment no sounds were played. The volume of the vocalizations in the sound treatment was not fixed: stockpersons applied the light and sound treatments, and were asked to adjust the volume on the CD player so that the vocalizations were approximately as loud as if they were being made by very young piglets in the farrowing room.

Data Collection

Farm employees were responsible for data collection. A data sheet (Appendix A) was used to record information for each sow or gilt prior to, during and after farrowing. When the farrowing room was emptied, data sheets for that room's animals were collected and mailed to the investigators for collation and analysis.

For each sow or gilt, data were supplied thus:

Female:

a)parity

b)individual identification;

b)genetic line;

c)breeding date;

d)farrowing date;

e)pre-parturient condition score: assessed using a five-point body condition scoring system (Patience et al., 1995): score 1 = poor - hips and backbone are prominent; 2 = moderate - hips and backbone are easily felt without applying palm pressure; 3 = good - hips and backbone can only be felt with firm palm pressure; 4 = very good - hips and backbone cannot be felt; 5 fat - hips and backbone are heavily covered;

Environment:

f)farrowing room;

g)farrowing crate number;

Farrowing:

h)induction or non-induction of farrowing;

i)use or non-use of manual intervention;

j)use or non-use of oxytocin augmentation;

Litter:

k)total litter size;

l)number of piglets born alive;

m)number of male and female piglets (used by experimenters to calculate litter sex ratio (number of male piglets/(number of male plus female piglets));

Aggression and mortality:

n)piglet-directed aggression as observed by stockpersons: score 0 = no aggression; 1 = moderate aggression, not resulting in piglet injury or death and not requiring intervention; 2 = severe aggression, resulting in piglet injury or death, or requiring intervention to control it;

o)number of piglets killed by savaging (or which sustained injuries incompatible with life);

p)number of piglets non-fatally injured by savaging;

r)number of live-born piglets dying before weaning of any cause.

Statistical Analysis

Separate analyses were performed on the first and second farrowing cycles. Comparisons between cycles were made using t-tests on farm means when appropriate. Independent variables were considered to be management group; sow parity; light and sound treatments (which were applied on a farrowing room basis and hence also represented rooms); farrowing room zone (front; middle; back; Figure 1); time (represented by farrowing room fills 1-4) and genetic line. Data from the first batch of farrowings in each room was classified as fill 1, the second complete batch was fill 2, the third fill 3 and the fourth fill 4. Although for some farms and some rooms data were available for fills 5 and 6, fills 1-4 only were used in the analysis of effects of time, since this data set was relatively complete. Parity was only included in the analysis of the second cycle. Time and genetic line were only analysed for the first cycle. Data for the 2400 animal farm which supplied records from only the second half of the first farrowing cycle were not included in the analysis of effects of time.

The effects of gestation length; gilt condition score; induction or non-induction of farrowing (scored as 1 or 0); manual intervention in farrowing or non-intervention (scored as 1 or 0); augmentation of farrowing with oxytocin or non-augmentation (scored as 1 or 0); total litter size; number of piglets born alive; and piglet sex ratio were also assessed via partial correlation analysis within the first farrowing cycle.

Eight dependent aggression and mortality variables were used: females' piglet-directed aggression score (0, 1 or 2); females' fatal savaging score (scored as 1 if she killed one or more piglets by savaging, and 0 if she did not); the number of piglets per litter killed by savaging; the number of piglets per litter non-fatally injured by savaging; the number of liveborn piglets per litter that died before weaning of any cause; savaging deaths as a percentage of total piglet deaths;

savaging deaths as a percentage of live litter size; and savaging injuries as a percentage of live litter size.

Statistical data were analysed according to a multiple split plot model, using the General Linear Model (GLM) procedure of SAS (SAS Institute Inc., 1990). The main plot of the model was management group, with the effects of parity, the effects of light and sound treatments, farrowing room zone and time as progressive sub-plots nested within management group. The complexity of the statistical model necessitated executing a second version of the analyses of effects of farrowing room zone and time (the program for which utilized an incorrect error term), in order to obtain probability values and calculate standard errors. It was not possible to accurately compare means for these levels of analysis, and thus where significant single or interaction effects were found, these were further examined using orthogonal contrasts.

Effects of genetic line were analysed separately for the two management groups, as an additional sub-plot. Residuals of the above analyses on the first farrowing cycle were used to create partial correlation coefficients, testing the relationships between the eight aggression and mortality variables and gestation length, gilt condition score, induction or non-induction of farrowing, use or non-use of manual intervention in farrowing, use or non-use of oxytocin augmentation, and total and live litter size.

The records of 200 hundred gilts involved in the first farrowing cycle were examined to determine if they were retained for the second cycle, and if they did or did not savage piglets to death during their second parity. In order to obtain sufficient numbers of savaging gilts in this analysis, up to 20 additional animals that had killed a piglet during their first parity were included from each farm. Chi-square analyses were performed to determine if savaging and non-savaging gilts differed in their retention rates within the herds, and, if retained, in their propensity to savage during their second parity.

Results

Table 1 summarizes mortality and aggression data for each for the seven farms involved in the study. Data were obtained on 6625 gilts during the first farrowing cycle, and on 2175 gilts and 5232 sows during the second. During the first farrowing cycle, 506 (0.77%) piglets were affected (killed or injured) by savaging; of these, 392 (0.60%) piglets were killed. Three hundred and thirty one gilts (5.3%) displayed some degree of aggression towards their piglets (scoring either 1 or 2), while 271 (4.1%) displayed severe aggression (scoring 2). Two hundred and one gilts (2.9%) killed one or more piglets. There was considerable variation between farms in reported incidence of savaging and numbers of piglets affected. Percentages of piglets killed by savaging (of piglets born alive) ranged from 0.1%-1.1%, and percentages of gilts killing one or more piglets ranged from 0.8% to 5.8%. Thus, the contribution made by savaging to total preweaning piglet mortality varied between little (3% for farm A-1) and very considerable (25% for farm B-6). On average, savaging deaths represented 11.2% of total reported preweaning mortality.

Effects of parity and repeatability of savaging

Comparisons between gilts in the first and second cycles indicated that there were no differences in any of the aggression or savaging variables. During the second farrowing cycle, gilts and sows differed for all of the aggression and savaging variables (Table 2). In general, gilts were twice as likely to show aggression or to actually kill a piglet, and twice as many piglets were killed by gilts than by sows.

Analysis of the data on retention rate and subsequent savaging (Table 3), indicated that an equal proportion of savaging and non-savaging gilts were retained in the herd for a second parity. During that second parity, those that savaged piglets in their first litter were more likely to savage again (14%) than those that did not savage during their first parity (<1%; $P<0.05$).

Effects of management group

There were no significant differences between the management groups in percentages of farrowings induced, or during which manual intervention or oxytocin were used. The two groups did not differ in total or live litter size, numbers of male piglets per litter born alive or dead, numbers of female piglets per litter born dead, the sex ratio of litters or total reported preweaning piglet mortality. There was a tendency towards more female piglets born alive per litter on farms belonging to management group B than those belonging to group A. Aggression variables (aggression score, fatal savaging score, numbers and percentages of piglets savaged to death, and numbers and percentages of piglets injured due to savaging) did not differ between farms belonging to the two groups.

Effects of light and sound treatments

Effects of the sound and light treatments on aggression and mortality variables are summarized in Tables 4 and 5. There was no effect, either alone or in interaction with other factors, of light and sound treatments on gilts' or sows' piglet-directed aggression score. Similarly, numbers and percentages of piglets injured by savaging were not affected by the treatments. Gilts' fatal savaging score, numbers and percentages of piglets savaged to death and reported preweaning piglet deaths per litter were not affected by the sound treatment alone. During the first farrowing cycle, in rooms receiving the continuous light treatment, there was a reduction in the proportion of gilts killing piglets ($p<0.05$), in numbers of piglets per litter savaged to death (0.052 vs. 0.084; $p<0.05$), in savaging deaths as a percentage of total reported preweaning mortality ($p<0.1$) and in savaging deaths as a percentage of live births ($p<0.1$) compared to rooms receiving intermittent light. There was also a reduction in reported preweaning piglet deaths per litter (0.62 vs 0.74; $p<0.05$) when the continuous light treatment was applied. During the second farrowing cycle, the same trends in variables were observed, but none of the differences were significant.

Although the sound treatment did not affect any of the variables measured within the first farrowing cycle, there was a trend towards a significant interaction between the effects of management group and sound treatment on number of piglets per litter savaged to death. On group B farms there were more savaging deaths per litter in rooms receiving the sound treatment (mean ± s.e. = 0.102 ± 0.018) than in rooms receiving no sound (0.057 ± 0.015; $p<0.1$). On group A farms this difference did not occur (sound mean ± s.e. deaths = 0.053 ± 0.011; no sound = 0.062 ± 0.010). This difference was not reflected in gilts' fatal savaging score, savaging deaths as a percentage of preweaning piglet deaths or savaging deaths as a percentage of live litter size.

Effects of farrowing room zone

There were few effects of farrowing room zone on aggression and savaging during the first farrowing cycle. The proportion of gilts killing one or more piglets tended to increase from the front of the room (nearest door) to the back (2.46, 3.27 and 4.08% in front, middle and back, respectively; $p<.10$). Similarly, savaging deaths as a proportion of total mortality tended to be higher in the back of the room as well ($p<0.10$).

There was a significant interaction between the effects of sound treatment and zone on number of piglets per litter savaged to death. In rooms receiving the sound treatment, there were more savaging deaths per litter in the middle zone (mean ± s.e. = 0.116 ± 0.018) than in either the front (0.045 ± 0.018) or back (0.072 ± 0.018; $p<0.05$). In rooms receiving no sound this difference did not occur (middle zone mean ± s.e. deaths = 0.046 ± 0.016; front = 0.052 ± 0.016; back = 0.076 ± 0.016). In rooms receiving the sound treatment there were more savaging deaths as a percentage of total reported preweaning piglet deaths in the middle zone (mean ± s.e. = 3.57 ± 0.72) than in either the front (1.52 ± 0.72) or back (2.84 ± 0.72; $p<0.1$). In rooms receiving no sound, however, savaging represented a greater proportion of total mortality in the back zone (mean ± s.e. = 3.78 ± 0.63) than in either the middle (1.65 ± 0.63) or the front (1.94 ± 0.63).

There was a significant interaction between the effects of light treatment and zone on reported preweaning piglet deaths. In rooms receiving intermittent light there were more piglet deaths in the middle zone (mean ± s.e. = 0.864 ± 0.051) than in the front (0.626 ± 0.051) or back (0.731 ± 0.051; $p<0.05$). In rooms receiving continuous light this difference did not occur (middle zone mean ± s.e. deaths = 0.609 ± 0.055; Front = 0.660 ± 0.055; Back = 0.596 ± 0.055).

There were no significant effects of zone or interactions involving zone during the second farrowing cycle.

Effects of time

There was no effect of time alone on fatal savaging score, on numbers or percentages of piglets savaged to death or injured by savaging, or on total reported preweaning piglet deaths. There was, however, a tendency towards an effect of time on piglet-directed aggression score ($p<0.1$), with a reduction in aggression scores during fills 3 and 4 compared to fills 1 and 2.

Effects of genetic line

Genetic line did not affect aggression variables, alone or in interaction with sound and light treatments, on farms belonging to either group A or group B. Genetic line alone also had no effect on total reported piglet mortality on either group A or group B farms, and on group B farms, there was also no effect of genetic line in interaction with sound and light treatments. On group A farms there was an interaction between genetic line and sound treatment on total reported piglet mortality. In line A2 gilts there were more total reported piglet deaths when the sound treatment was applied (mean ± s.e. deaths = 0.799 ± 0.069) than when there was no sound (0.594 ± 0.064; $p<0.05$). In line A1 gilts this difference did not occur (sound = 0.705 ± 0.069; no sound = 0.769 ± 0.064).

Partial correlations between residual factors

Partial correlations between residual factors and aggression variables during the first farrowing cycle are shown in Table 6. As expected, the eight aggression and mortality variables (gilts' aggression score; gilts' fatal savaging score; number of piglets per litter killed by savaging; savaging deaths as a percentage of reported preweaning piglet deaths; savaging deaths as a percentage of live births; number of piglets per litter non-fatally injured by savaging; savaging injuries as a percentage of live births; reported preweaning piglet deaths) were all highly significantly positively correlated.

Gilts' gestation length was not related to any aggression variable, although there was less preweaning mortality when gestation length was longer.

There was no relationship between gilts' body condition score and preweaning mortality, aggression score or piglet savaging deaths. There were small, tending towards significant, negative correlations between gilt condition score and numbers of piglets per litter injured due to savaging, and between gilt condition score and savaging injuries as a percentage of live births: the lower the condition score (meaning that the gilt was thinner), the more piglets were injured by savaging.

There was no relationship between induction or non-induction of farrowing or the use or non-use of manual intervention in farrowing and aggression or savaging variables. There tended to be less preweaning mortality when induction was used. There was no relationship between use or non-use of oxytocin during farrowing and aggression or mortality variables except for savaging injuries as a percentage of live births: there was a small, tending towards significant, positive correlationbetween savaging injuries as a percentage of live births and use of oxytocin. Oxytocin use was associated with more savaging injuries as a percentage of live births.

There were very significant, positive correlations between total and live litter size and preweaning mortality: more mortality occurred in larger litters. There were small, tending towards significant positive correlations between total litter size and gilts' fatal savaging score,

number of piglets per litter killed by savaging and number of piglets per litter injured by savaging. Live litter size, however, was associated only with number of piglets per litter injured by savaging, with which there existed a small, tending towards significant positive correlation. There was also a small, tending towards significant negative correlation between number of piglets per litter savaged to death and litter sex ratio: in litters with a higher sex ratio (containing a higher proportion of males), there were marginally fewer savaging deaths.

Discussion

There was considerable variability across the study farms in reported total preweaning mortality, in average piglet-directed aggression scores, and in numbers and percentages of piglets killed and injured due to savaging. This variation occurred within, rather than between, management groups. There are several possible explanations for the marked differences reported. One is that mortality and aggression did differ widely between farms. If this was the case then a limited number of factors could be responsible (given that facilities, management, procedures and genetic lines were similar or identical within the management groups). It is possible that individual stockperson behaviour contributed to the differences observed. It has been documented (e.g. by Hemsworth and Coleman, 1998) that farm animals' productivity and behaviour can be affected by human attitudes and behaviour. Another possibility is that stockpersons' perception of gilts' behaviour may have affected the data reported. Although guidelines were given to stockpersons on the diagnosis of piglet-directed aggression and piglet death due to savaging, survey data are heavily reliant on the personal interpretation and perception of those collecting the data. As reported by Christensen and Svensmark (1997), producers are not always accurate in their diagnosis of the causes of piglet mortality. It would appear, however, that death by savaging might be one of the easier causes to diagnose, since it generally has distinct hallmarks: bites to the head and face, and possibly other parts of the body, with the piglet located close to the front of the crate. Producer co-operation in consistently supplying full information is also a concern when using survey data. In this study, preweaning mortality data was not always supplied, and the extent of this omission varied from farm to farm. Therefore, reported preweaning mortality levels do not accurately represent the true magnitude of mortality. Individual farms also differed in the extent to which they consistently completed other parts of the data sheets.

The overall percentage of gilts who fatally savaged one or more piglets in this study was approximately 3%, with the reported incidence ranging from 0.8% to 5.8%. This suggests that the findings of our previous study (during which 5-7% of gilts engaged in fatal savaging behaviour) were influenced by an unusually high level of aggression in the study population. The variability in our findings may in part explain some of the disparity in previously-reported estimates of the incidence of savaging behaviour. This variation also illustrates a potential difficulty in interpreting the results of behaviour (or other) studies where comparisons are made between two different farms or herds.

Reporting only numbers and percentages of piglets killed and injured by savaging underestimates the magnitude of piglet-directed aggression. Parturient sows and gilts may engage in aggression which does not result in physical injury, but which may be detrimental to their offspring, and which may not be detected unless farrowing is observed continuously. In this study, farrowing was not systematically observed, but stockpersons were asked to note the occurrence of any observed offspring-directed aggression that they saw while in the farrowing rooms. It was recorded that five per cent of gilts (range 1.7% - 10.7%) engaged in some degree of piglet-directed aggression. Aggression scoring is clearly a subjective measure, which is very susceptible to both the stockperson's degree of vigilance and his/her perception of the significance of behaviour. It is very probable that higher levels of offspring-directed aggression would have been noted, had farrowing been continuously and systematically observed.

The comparison of sows and gilts in the second farrowing cycle confirms previous reports that sows savage much less frequently than do gilts. Contrary to our findings in a preliminary study, gilts in the second farrowing cycle, when sows were also present in the farrowing room, savaged at similar levels as gilts in the first cycle. The presence of sows in the room did not have a calming effect on the gilts giving birth.

The farms retained a similar proprtion of savaging and non-savaging animals for the second farrowing cycle. These results confirm the stated management policy of the farms that

they did not cull based on savaging. However, those animals that savaged during the first farrowing cycle were nearly 20 times more likely to savage during their second parity. Approximately 10% of those animals that savaged during their first parity did so again during their second. These results suggest that savaging should be considered during culling decisions.

The continuous light treatment resulted in a marked reduction in total reported preweaning piglet mortality, and reduced piglet deaths due to savaging. Over 50% of piglet losses have been reported to occur in the first two to three days after birth (Bauman et al., 1966 ; English and Smith, 1975; Glastonbury, 1976), and presumably a sizeable percentage of these deaths occur during the farrowing process itself. This may partly account for how a treatment imposed for a relatively short period (only until the last gilt in the room had finished farrowing) had such an impact on total preweaning mortality. Mabry et al. (1983) exposed sows and litters to either 8 hours light: 16 hours dark or 16 hours light: 8 hours dark from day 107 of gestation until weaning at 28 days, recording more frequent suckling, higher 21 day litter weights and possibly increased piglet survival in litters receiving 16 hour-a-day light. It is possible, therefore, that reduced piglet mortality in this study may have resulted from more frequent suckling with 24-hour-a-day light during the initial 1-2 days post-farrowing. The mechanism for the reduction of piglet savaging deaths with continuous light is unknown, and merits further investigation. One theory on savaging is that gilts are frightened by newborn piglets and this leads to an attack. Well illuminated rooms may allow gilts to better see approaching piglets and reduce their fear response.

The sound treatment, consisting of newborn piglet vocalizations, was designed in an attempt to accustom pre-parturient gilts to piglet stimuli, as a possible method of reducing piglet-directed aggression. It did not have this effect, however, and on some farms it appeared to increase savaging deaths, although not the numbers of gilts savaging. The increase in savaging deaths in the central zone of farrowing rooms receiving the sound treatment may be attributable

to a greater concentration of sound in the central zone than in the front or back, due to the placement of the speakers within the rooms.

We had hypothesized that the incidence of savaging would decrease over time from the start-up of the new units, as both people and pigs became more familiar with their surroundings. There was a tendency for aggression to decrease over time. Our hypothesis is that as farrowing management becomes more routine on a farm, gilts are less likely to become upset due to the predictable procedures, and less likely to react aggressively when piglets arrive.

Although it has been anecdotally suggested that savaging is more prevalent in certain genotypes, this study found no evidence of any association between genetic line and savaging. We included several hybrid lines to which we had access: using other genotypes might have resulted in different findings.

Similarly, little relationship was found between gilts' gestation length, condition score, the induction of or intervention in farrowing or litter sex ratio and piglet-directed aggression or savaging. Where correlations existed among these variables, they were of very small magnitude, and only marginal significance. There was some evidence, however, supporting our previously-noted relationship between savaging and litter size: total and live litter size were positively correlated with several aggression and savaging variables. Again, however, these correlations were of very small magnitude and marginal significance. This relationship is also complicated by the demonstrated close association between litter size and preweaning mortality (also noted by Nielsen et al., 1974). The increase in piglet deaths from all causes in larger litters makes the interpretation of the increased savaging deaths in larger litters more difficult.

There were no significant effects of light, sound or zone in the second farrowing cycle. It is possible this lack of effect was due to the dilution of savaging by the presence of low savaging sows. Management to reduce savaging must be implemented during the first farrowing cycle to be most effective in reducing mortality on farms.

Conclusions

1. Combining a survey format with experimental data is an excellent tool for compiling large amounts of data, particularly when collecting information on the incidence and correlates of an infrequent behaviour. Quantity of information may be increased at the expense of detail however, since it is not possible for investigators to closely monitor the accuracy of data gathering.
2. We have confirmed that first parity animals (gilts) have a much higher rate of savaging and piglet directed aggression than do sows.
3. The incidence of savaging by gilts is not affected by the presence of sows in the farrowing room. Savaging by gilts is similar in the first two farrowing cycles in a new barn.
4. Savaging, or at least the recognition of savaging, varies considerably among farms, but did not vary consistently between farm management groups.
5. Savaging did not differ among the genetic lines included in this study.
6. The presence of continuous light in the farrowing room reduces the incidence of savaging and overall piglet mortality. Farms should be encouraged to provide continuous light throughout the farrowing period.
7. The playback of newborn piglet sounds did not reduce the incidence of savaging, and in some cases appeared to increase the number of savaging deaths. Extraneous sounds should be minimized during farrowing.

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Figure 1. Schematic representation of farrowing room layout on Group A and Group B farms, indicating location of crates in the front (F), middle (M) and back (B) zones. Half-sized rooms on Group B farms contained crates 1-12 only. The location of wall speakers is indicated by Xs.

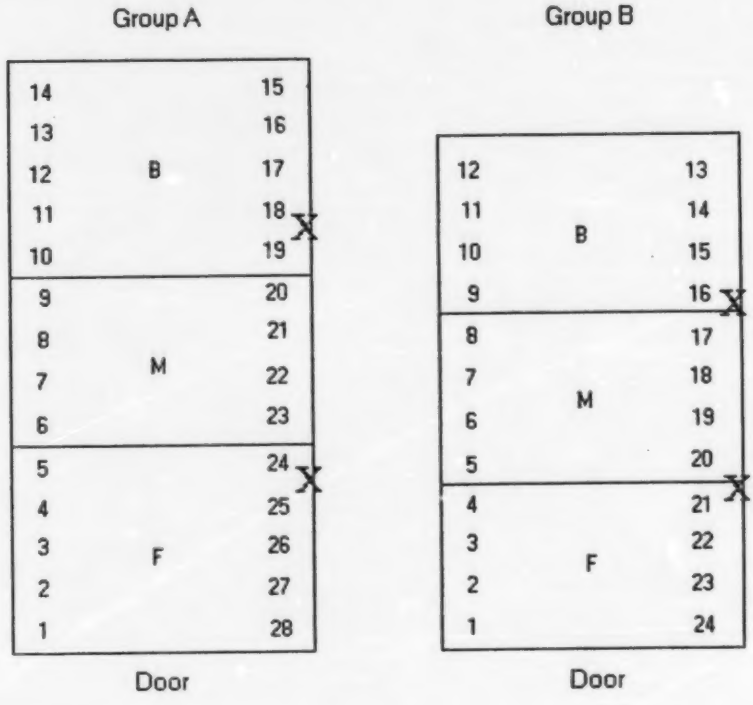

Table 1. Number of females and mean values for aggression scores, % of piglets killed by savaging, and % of females killing piglets on seven farms over the first two farrowing cycles.

	Farm							
Item	1(CT)	2(ED)	3(HZ)	4(CF)	5(HB)	6(LM)	7(PP)	Mean
Number of females								
1st cycle gilts	2157	1918	547	496	482	547	478	946.43
2nd cycle gilts	278	491	930	190	135	79	72	310.71
2nd cycle sows	1175	1246	1254	378	433	452	294	747.43
Average aggression score								
1st cycle gilts	0.0332	0.1573	0.0920	0.1543	0.0938	0.1076	0.0532	0.0988
2nd cycle gilts	0.0435	0.1505	0.1170	0.0608	0.0909	0.0256	0.0563	0.0778
2nd cycle sows	0.0138	0.0412	0.0458	0.0839	0.0185	0.0312	0.0410	0.0393
Savaging deaths (# of piglets savaged to death per litter)								
1st cycle gilts	0.0116	0.1097	0.0575	0.0450	0.0397	0.1188	0.0867	0.0670
2nd cycle gilts	0.0324	0.0815	0.0548	0.0316	0.0597	0.0506	0.0417	0.0503
2nd cycle sows	0.0076	0.0225	0.0183	0.0107	0.0092	0.0487	0.0646	0.0260
Savaging deaths (as % of total deaths)								
1st cycle gilts	3.02	12.16	8.96	4.59	10.67	25.00	14.13	11.22
2nd cycle gilts	3.72	14.60	7.39	3.85	8.33	7.02	5.36	7.18
2nd cycle sows	1.15	4.58	2.87	1.20	1.32	6.04	6.69	3.41
Savaging deaths (as % of live births)								
1st cycle gilts	0.12	1.07	0.49	0.40	0.37	0.98	0.81	0.61
2nd cycle gilts	0.34	0.85	0.56	0.31	0.52	0.51	0.42	0.50
2nd cycle sows	0.08	0.23	0.19	0.09	0.08	0.45	0.56	0.24
% of females killing piglets								
1st cycle gilts	0.83	5.84	2.74	2.62	2.49	3.66	2.30	2.93
2nd cycle gilts	2.16	5.70	3.33	1.05	2.99	1.27	2.78	2.75
2nd cycle sows	0.51	1.85	1.44	0.54	0.69	1.55	1.70	1.18

Table 2: Comparison of piglet directed aggression between gilts and sows during the second farrowing cycle on seven new farms.

Item	Gilts	Sows	SEM	P
Number of animals[1]	2175	5232		
Average aggression score	0.0811	0.0386	0.0110	0.0417
Piglets killed by savaging (as % of total deaths)	7.18	3.41	1.18	0.04
Piglets killed by savaging (as % of live births)	0.50	0.24	0.07	0.02
% of females showing some aggression	4.30	2.28	0.60	0.0214
% of females killing one or more piglets	2.8759	1.1918	0.0031	0.0116

[1] Results from the seven farms were the experimental unit.

Table 3. Number[1] of savaging and non-savaging gilts that were culled, or that did or did not savage during the second parity.

First parity behaviour	2nd Parity		
	Not retained in herd	Savaged	Did not savage
Savaged	40	10	61
Did not savage	403	8	954

[1] Represents a sample of total data. A higher proportion of savaging gilts are reported than represented in the total data in order to improve statistical comparison.

Table 4: Comparison of piglet directed aggression between light treatments during the first two farrowing cycles on seven new farms.

Item	1st Cycle				2nd Cycle			
	Standard light	24-hour light	SEM	P	Standard light	24-hour light	SEM	P
Number of animals								
Average aggression score	0.1130±0.012	0.0870±0.011		n.s.	0.0672±0.0085	0.0541±0.0093		n.s.
Piglets killed by savaging (as % of total deaths)	13.03	8.94	2.95	0.06	5.36	3.49	1.25	n.s.
Piglets killed by savaging (as % of live births)	0.77	0.47	0.15	0.07	0.36	0.41	0.09	n.s.
% of sows showing some aggression	6.20	5.10	1.0	n.s.	3.64	2.95	0.60	n.s.
% of sows killing one or more piglets	4.11±0.005	2.45±0.005		0.02	2.07±0.0033	2.01±0.0035		n.s

Table 5: Comparison of piglet directed aggression between sound treatments during the first farrowing cycles on seven new farms.

Item	1st Cycle				2nd Cycle			
	No sound	Sound	SEM	P	No sound	Sound	SEM	P
Number of animals[1]								
Average aggression score	0.101±0.011	0.034±0.005		n.s	0.068±0.008	0.053±0.009		n.s.
Piglets killed by savaging (as % of total deaths)	9.96	12.01	2.95	n.s.	4.86	5.98	1.25	n.s.
Piglets killed by savaging (as % of live births)	0.52	0.72	0.15	n.s	0.35	0.41	0.09	n.s.
% of females showing some aggression	5.7±1.0	5.6±1.0		n.s.	3.79±0.60	2.79±0.60		n.s
% of females killing one or more piglets	3.21±0.004	3.35±0.005		n.s	2.26±0.003	1.83±0.004		n.s.